REMARKS

The present application is in condition for allowance at the time of the next Official Action.

Claims 1-20 were rejected under 35 USC §103(a) as being unpatentable over FLODIN US 6,210,441 ("FLODIN"). The rejection is respectfully traversed for the reasons below.

The position of the Official Action was that it would have been obvious to modify Example 5 and instead select 60°C as the reaction temperature, as column 4 lines 40-43 of FLODIN discloses that the reaction temperatures are not limited to 70°C as the minimum.

However, for at least four reasons the proposed modification fails to render obvious the claimed invention.

I. There is no suggestion to modify the temperature of example 5.

The cited temperature range of column 4 is a general statement of possible temperatures, and does not specifically refer to the formation of the prepolymer of Example 5. Indeed, no other Example suggests lowering the temperature towards 60°C.

Moreover, example 5 clearly states "at a maintained temperature of 70-80°C". That is, for this particular combination of reactants, 70-80°C appears to have been selected by FLODIN to produce the desired prepolymer, which is used to produce the desired polymer.

Thus, one of ordinary skill in the art would have been discouraged from reducing the reaction temperature of the example, as there is no indication of the effect of a reduced temperature on the desired exemplified product.

II. The ratio of esterdiol to aromatic diisocyanate larger than 2:1 is not disclosed.

FLODIN discloses that a ratio of 2 is selected for the shortest prepolymers, and for longer prepolymers a ratio of less than 2 is selected. See, column 4, lines 22-45.

While the Examples appear to suggest a greater ratio, a ratio larger than 2:1, as recited in claim 1, is actually contrary the teachings of FLODIN as a whole, e.g., in view of column 4, lines 22-25. Moreover, FLODIN also does not suggest the effect of a ratio greater than 2:1, e.g., a short prepolymer with a narrow distribution of hard and soft block lengths, as also recited in claim 1.

The present invention is a linear block polymer with alternating "hard" and "soft" blocks/segments, and these blocks/segments are short. As a result, a low elongation at break is achieved, which also affects the degradation rate.

For also this reason, example 5 of FLODIN appears to suggest a polymer contrary to claimed invention. The elongation at break is 200% in example 5, whereas to the claimed invention forms a fiber with elongation break of less than 100%.

III. The values $0 < y < 4$ and $z > 8$ are not disclosed.

The claimed y and z values are measures of the length of the hard blocks and the repeating unit of the polymer, respectively.

The key element in the claimed polyurethane urea is the combination of more urea than urethane groups with very short length of the hard blocks/segments. The "more urea than urethane groups" is governed by the NCO/OH-ratio (R2/R3) being >2. The lengths of the hard blocks "y" are stated to be 0< y <4 (which is not an average value). These features are defined in claim 1.

The length of the hard blocks in the resulting claimed polyurethane urea depends on the amount of unreacted monomeric diisocyanate in the prepolymer. For "y"=0, the two prepolymer molecules have been joined together by a diamine. For "y"=4, four monomeric diisocyanate molecules and five diamine molecules have been incorporated into the hard block between two prepolymer molecules. To keep the hard blocks short the amount of monomeric diisocyanates in the prepolymer has to be kept low.

The prepolymerization is a polymerization reaction and therefore a distribution of chain lengths and also unreacted monomers are present in the prepolymer. An NCO/OH-ratio of 2 does not result in all prepolymer molecules being diisocyanate-diol-diisocyanate. The structure of the polymer is determined by both (i) the stoichiometric ratios of the reactants and (ii) the process by which the reactants are allowed to react with each other.

The NCO/OH and the NCO/amine ratios determine the average structure of the pre-polymer and the polymer, respectively.

As discussed above, FLODIN discloses that a ratio of NCO/OH = 2 gives the shortest possible pre-polymer (column 4, lines 35-40). However, different pre-polymers can be obtained depending on how the polymerization is carried out.

For example, if the reactants are mixed together, one obtains a wide distribution of chain lengths with a higher number of long pre-polymer molecules and a higher number of diisocyanate molecules that have not taken part in the reaction. If one adds the diol very slowly, one obtains a more narrow chain length distribution with a lower number of long molecules and a lower number of "un-reacted" diisocyanate molecules. Nevertheless, in either case, the <u>average</u> of the NCO/OH ratio <u>may be</u> 2.

Long prepolymer molecules form long soft blocks in the product polymer, and short prepolymer molecules form short soft blocks in the product polymer. When the amine is added to the prepolymer in the next step, <u>long</u> hard blocks will be formed in the product polymer if <u>large</u> amounts of unreacted diisocyanate molecules are present, and <u>short</u> hard blocks will be formed if <u>small</u> amounts of unreacted diisocyanate molecules are present. However, the NCO/amine ratio can be the <u>same</u> in both cases.

In the present invention, it is of interest to form short segments, i.e., a small y-value. Therefore, it is

desirable to have a narrow chain length distribution of the prepolymer.

The polymer according to FLODIN, however, contains a relatively high fraction of hard blocks. Improved mechanical properties of this polymer may be obtained by increasing the fraction of hard blocks, but this is risky since this also increases the risk of forming a gel during processing. It is thus not obvious how to improve the mechanical properties without risking ending up with a polymer solution that is not possible to process.

In the present invention, the length of both the hard and the soft blocks has been shortened. However, this is not accomplished by choosing particular reactants, but by modifying the process of forming the prepolymer.

Compared to FLODIN, the pre-polymerization is carried out at lower temperature, e.g., 50- 60°C, and in the absence of catalyst. (FLODIN requires a catalyst for temperatures less than 60-80°C.) This way the reaction can be controlled to yield a more narrow chain length distribution of the prepolymer.

The differences in the process for forming the pre polymer results in a product polymer with an y-value that differs from the polymer formed by FLODIN. This is a further difference between the present invention and FLODIN, i.e., in addition to the differing R2/R3-ratio.

IV. The general knowledge of one of ordinary skill in art at the time that the invention was made.

P. J. FLORY has described the issue of unreacted diisocyanate in a well known article that forms an example of common general knowledge and that still is applied in polymer science (J. Am. Chem. Soc., 58, (1936), 1877-1885).

By using FLORY's description and assuming all diisocyanate and all diol are mixed at once and also assuming completeness of reaction, i.e. all diol groups are reacted as there is excess diisocyanate, the following results from equation 30b in the FLORY article.

An NCO/OH-ratio of 1.6 results in 37 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 20 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

An NCO/OH-ratio of 2 results in 50 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 6 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

An NCO/OH-ratio of 2.4 results in 58 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 3 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

The NCO/OH-ratio of 2 will further result in an average hard block length corresponding to a "y"-value of over 4, based

on the results calculated from FLORY's description. Moreover, increasing the NCO/OH-ratio above 2 will result in increasing amounts of unreacted monomeric diisocyanate and an NCO/OH-ratio of 2.4 will result in an average hard block length corresponding to a "y"-value of over 5.

As can be seen from these calculations the two requirements, more urea than urethane groups and very short hard blocks contradict each other. Increasing the NCO/OH-ratio in the prepolymer reaction increases the amount of unreacted monomeric diisocyanate in the prepolymer which leads to longer hard blocks in the final polyurethane urea.

Thus, common general knowledge at the time the invention was made (e.g., the FLORY-article) was that using a high R2/R1 ratio results in large amounts of unreacted diisocyanate which in turn results in long hard blocks and thus an y-value of <u>greater than</u> 4.

To increase the NCO/OH ratio above 2 <u>and</u> keep the hard block length "y" of all polymer chains <u>less than</u> 4 would have been <u>unobvious</u> to those skilled in the art, not to mention how to accomplish this, i.e., by a slow addition, drop by drop of diol to a bulk of diisocyanate at a temperature at or below 60°C. This procedure gives the desired material properties with respect to toughness, elongation and degradation.

Therefore, the proposed combination does not render obvious the claimed invention, and withdrawal of the rejection is respectfully requested.

In view of the amendment to the claims and the foregoing remarks, the application is in condition for allowance at the time of the next Official Action. Allowance and passage to issue on that basis is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

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